CERTIFICATION

I, Mihaela BOARU, whose address is Nichimen Building 2F, 2-2, Nakanoshima 2-chome, Kita-ku, Osaka-shi, Osaka, Japan, hereby certify that I am the translator of the attached document, namely,

Japanese Patent Application No. 2002-312435,

that I am familiar with both the Japanese language and the English language, and that the translation is a true and correct translation from the Japanese language to the English language to the best of my knowledge and belief.

This 5th day of September, 2006

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【Title of the Invention】

SEMICONDUCTOR LASER DRIVING DEVICE, OPTICAL HEAD DEVICE, OPTICAL INFORMATION RECORDING AND REPRODUCING DEVICE

【Claims】

【Claim 1】

A semiconductor laser driving device comprising:

a semiconductor laser;

a high-frequency superimposing circuit for superimposing a high-frequency signal over a driving signal of the semiconductor laser;

a photodetecting element for receiving a part of light emitted from the semiconductor laser and converting the part of light into an electric signal corresponding to a light amount;

wherein an amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed in such a manner that a ratio of a peak value of the electric signal with respect to the average value of the electric signal becomes lower than or equal to a constant value.

【Claim 2】

A semiconductor laser driving device according to claim 1, wherein a wavelength of the light emitted from the semiconductor laser is $390nm < \lambda < 420nm$.

【Claim 3】

A semiconductor laser driving device according to claim 2, wherein the amplitude of the signal to be superimposed by means of the high-frequency superimposing circuit is changed based on information regarding the peak value and average value of the signal acquired from the photodetecting element.

【Claim 4】

A semiconductor laser driving device according to claim 2, further comprising a temperature sensor; and a storing section,

wherein the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed based on the temperature of the semiconductor laser detected by the temperature sensor and the conditions stored in the storing section.

【Claim 5】

A semiconductor laser driving device according to claim 3 or 4, further comprising an optical disc as the storing section, wherein the amplitude of the high-frequency superimposing circuit is changed further based on the information stored on the optical disc.

【Claim 6】

A semiconductor laser driving device according to any one of claims 2 to 5, wherein the device is constructed in such a manner that the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing

circuit decreases as the temperature of the semiconductor laser increases.

【Claim 7】

A semiconductor laser driving device according to any one of claims 2 to 5, wherein the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit decreases as the light emission power increases when the light emission power of the semiconductor laser is equal to or less than a given threshold value, whereas the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit increases as the light emission power increases when the light emission power of the semiconductor laser is equal to or larger than the threshold value.

【Claim 8】

An optical head device comprising the semiconductor laser driving device according to any one of claims 2 to 7.

【Claim 9】

An optical information processing device comprising the optical head device of claim 8.

【Detailed Description of the Invention】

【0001】

【Technical Field to which the Invention Pertains】

The present invention relates to an optical information processing device for recording/reproducing or erasing information on an optical medium such as an optical disc or an optical card,

etc., or a photomagnetic medium, and more in particular to an optical head device for emitting a laser beam, a semiconductor laser driving device to be used therein and an optical head device using such a semiconductor laser driving device, and an optical information processing device.

【0002】

【Background Art】

An optical memory technology which uses optical discs having pit-shaped patterns as high-density and high-capacity recording media is increasing its applications to wider ranges such as digital audio discs, video discs, text file discs, and also data files. With this optical memory technology, information is reliably and accurately recorded and reproduced on optical discs via finely condensed optical beams.

【0003】

The principle of the recording is briefly described as follows. For example, in the case of recording information onto a recording disc made of phase changing material, light with power relatively higher than the light irradiated in the case of reproducing information is irradiated onto the optical disc. The light irradiation induces a phase change in the material of the recording surface to create areas having different indexes of reflection, with the result that information is recorded or erased. Further, at the time of reproduction, light in an amount small enough not to induce the phase change is irradiated onto the optical disc. The reproduction of information is performed by

detecting the change in the index of reflection of the irradiated light.

【0004】

The recording and reproduction operations described above depend on their optical system. Basic functions of the optical head device, which is a main constituent element of the optical system, are roughly categorized into a converging function of forming minute spots of a diffraction limit by use of the light emitted from the light source, a focus control and tracking control function for the optical system, and a function of detecting pit signals. These functions are realized, in accordance with their individual purposes and applications, in combination of various optical systems and photoelectric conversion detecting methods.

【0005】

One of elements constituting the basis of the optical system is a light source. In general, a semiconductor laser is preferable as a light source for collecting light up to its diffraction limit. In an optical head device, a small-sized semiconductor laser is mainly used as a light source.

【0006】

In order to perform recording and reproduction with high reliability, the semiconductor laser to be used as a light source of the optical head is naturally required to have low noises.

【0007】

Semiconductor lasers are roughly categorized into two types: a single-mode laser and a multi-mode laser. Among them,

the single-mode laser has a problem that the wavelength of its emitting light is discretely changed due to the influence of the light returned from the optical disc and the like (referred to as a mode hop), and the change in the light amount accompanying the wavelength change is contained in the recording and reproducing signal as a noise. If the semiconductor laser is of a type that is largely influenced by the returned light, a large influence also appears on its laser oscillation itself. In this case, its oscillation may be unstable and its output may largely vary. In this state as it is, the recording and reproduction are also unstable, resulting in poor signal quality.

【0008】

On the other hand, the multi-mode laser emits light with plural wavelengths from the beginning, and is little influenced by noises caused by a mode hop, and therefore, is excellent as a light source for use in an optical head.

【0009】

However, it is difficult to constitute a multi-mode laser for some desired wavelengths and there are some cases where a desired wavelength is obtainable only in a single-mode laser. Further, depending on environmental conditions such as high temperature, the operation of the multi-mode laser may be unstable and its operation mode may change to single mode.

【0010】

In an attempt to solve such a problem, a method in which high frequency superimposing is applied to a single-mode laser to

change it into a multi-mode laser and thus-formed laser is used as a multi-mode laser is employed. Specifically, alternating current components at several hundreds MHz frequency obtained from an oscillating circuit of a high-frequency superimposed circuit are superimposed onto a laser driving current to allow the laser to operate in a multi-mode. In this manner, a practical light source affected by a suppressed level of the returned light and having a low noise is realized.

【0011】

This conventional technology is described with reference to Fig. 5 and Fig. 7.

【0012】

A laser driving current 66 outputted from a control device 64 is flown into a semiconductor laser 61 to emit light from this semiconductor laser 61.

【0013】

The semiconductor laser 61 is a single-mode laser.

【0014】

A photodetecting element 62 receives a part of the light emitted from the semiconductor laser 61 and performs photoelectrical conversion to the received light, thus outputting an electric signal which is proportional to the light amount. The control device 64 monitors the output from the photodetecting element 62, and controls the outputted current in such a manner that the outputted current takes a constant value. With the

structure described above, the semiconductor laser can be configured to emit light at a desired output level.

[0015]

The high-frequency superimposing circuit 63 receives an input from a power source for driving the high-frequency superimposing circuit and oscillates, thereby causing a high-frequency component to be superimposed on the laser driving current 66. At this time, by properly setting the oscillating amplitude and frequency of the high-frequency superimposing circuit 63, the semiconductor laser 61 is enabled to operate as a multi-mode laser. As a result of this, the noise of the semiconductor laser 61 caused by the returned light can be suppressed, and stable reproduction of the information from the optical disc can be performed.

[0016]

At this time, the change in the emitted light with respect to time is represented by the solid curve 51 in Fig. 7, for example. As is exemplarily illustrated in Fig. 7, the emitted light contains alternating current components having a period that corresponds to the oscillating frequency of the high-frequency superimposing circuit 63 due to the influence of the high-frequency superimposing. However, if the frequency of the high-frequency superimposing circuit 63 is set to a value sufficiently higher than the frequency band of the reproducing signal of the recording medium, by properly selecting the frequency characteristics of the photodetector that detects the reproducing signal, it is possible to

obtain a signal that is the same signal as of the case where reproduction is performed by the laser beam having only the direct current components with the same magnitude as an average value in terms of time shown by a wave line 53.

【0017】

【Patent Literature 1】

Japanese Unexamined Patent Publication 2001-352124

【0018】

【Problems to Be Solved by the Invention】

However, in the structure described above, the peak value of the light amount is higher than the average value of the light amount. For this reason, the power of the laser beam is larger than the average value during a very short period of time.

【0019】

Therefore, if the reproduction of information is performed by irradiating light onto the optical disc, although the detected reproducing signal is the same as the signal having a power of the average value, there are cases that the optical disc may cause slight phase changes a in the portions of the disc where the power becomes high for a short period of time. This is equivalent to overwriting or erasing information during reproducing the information even if the overwritten or erased portion is small. As a result, the original information recorded on the optical disc is damaged.

【0020】

The present invention has been made in order to solve the above problems, and an object thereof is to provide a semiconductor laser driving device, an optical head device and an optical information processing device that enable to obtain emitted light capable of reproducing information without damaging the information recorded on a recorded information medium, by changing the oscillating amplitude of the high-frequency superimposing circuit at the time of operating the high-frequency superimposing circuit, in such a manner that a ratio of a peak value with respect to the average value of the light outputted from the semiconductor laser becomes lower than or equal to a constant value.

【0021】

【Means to Solve the Problems】

A semiconductor laser driving device of the invention comprises: a semiconductor laser; a high-frequency superimposing circuit for superimposing a high-frequency signal over a driving signal of the semiconductor laser; a photodetecting element for receiving a part of light emitted from the semiconductor laser and converting the part of light into an electric signal corresponding to a light amount; wherein the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed in such a manner that a ratio of a peak value of the electric signal with respect to the average value of the electric signal becomes lower than or equal to a constant value.

【0022】

Further, a wavelength of the light emitted from the semiconductor laser is $390\text{nm} < \lambda < 420\text{nm}$.

【0023】

Further, the amplitude of the signal to be superimposed by means of the high-frequency superimposing circuit is changed based on information regarding the peak value and average value of the signal acquired from the photodetecting element.

【0024】

Further, it comprises a temperature sensor; and a storing section. The amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed based on the temperature of the semiconductor laser detected by the temperature sensor and the conditions stored in the storing section.

【0025】

Further, it is provided with an optical disc as the storing section. The amplitude of the high-frequency superimposing circuit is also changed in accordance with the information stored on the optical disc.

【0026】

Further, the device is constructed in such a manner that the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit decreases as the temperature of the semiconductor laser increases.

【0027】

Further, the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit decreases as the light emission power increases when the light emission power of the semiconductor laser is equal to or less than a given threshold value, whereas the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit increases as the light emission power increases when the light emission power of the semiconductor laser is equal to or larger than the threshold value.

【0028】

Further, an optical head device of the invention includes the semiconductor laser driving device.

【0029】

Further, an optical information processing device of the invention includes the optical head.

【0030】

【Embodiments of the Invention】

(First embodiment)

A first embodiment of the invention is hereinafter described with reference to Fig. 1 and Fig. 6.

【0031】

Fig. 1 is a circuit block diagram showing a laser driving device according to the first embodiment of the invention.

【0032】

In Fig. 1, 1 denotes a semiconductor laser, 2 denotes a photodetecting element, 3 denotes a high-frequency superimposing

circuit, 4 denotes a laser driving circuit, 5 denotes a high-frequency superimposing control device, 6 denotes a laser driving power source, and 7 denotes a peak detecting circuit and 11 denotes an area included in an optical head device comprising an un-illustrated optical system or the like.

【0033】

Fig. 6 is a diagram showing the waveform of the light outputted from the semiconductor laser at the time of the high-frequency superimposing.

【0034】

In Fig. 6, the horizontal axis shows time, and the vertical axis shows the intensity of light. Also, the waveform 51 shows an example of an optical waveform at the time of high-frequency superimposing. Dotted line 52 shows a peak value of the waveform 51, dotted line 53 shows the level of a temporal average value of waveform 51.

【0035】

The semiconductor laser 1 is, for example, a single-mode laser that emits light having a wavelength of 450nm. The semiconductor laser 1 emits light on the laser driving current 6 outputted from the laser driving circuit 4. At this time, the laser driving current 6, which is a semiconductor laser driving signal, is superimposed with a high-frequency signal (in this example, a current having a high frequency) by means of the high-frequency superimposing circuit 3. The high-frequency superimposing circuit 3 is provided with an oscillating circuit (not shown) that

oscillates at high frequencies of about 200MHz to 600MHz for example. The oscillating circuit is driven by a driving source (not shown). The laser driving current 6 is superimposed with a high-frequency signal by means of AC coupling.

[0036]

When inputted into the semiconductor laser 1, the high-frequency superimposed laser driving-current 6 causes the semiconductor laser 1, which is a single-mode laser, to emit light as a multi-mode laser, consequently reducing the influence to the light returned from the disc etc and then the noise.

[0037]

A major part of the light emitted from the semiconductor laser 1 is directed to the disc for recording or reproducing and a part thereof is received by the photodetecting element 2 which executes photoelectric conversion to thus-received light to output an electric signal proportional to the light amount.

[0038]

The laser driving circuit 4 captures the outputted electric signal and the current outputted from the laser driving circuit 4 is controlled in such a manner that a temporal average value, i.e. a direct current component of the signal is kept at a constant value. As a result, the average value of the power of the light emitted from the semiconductor laser 1 is kept constant. Accordingly, the semiconductor laser can emit light at a desired output level.

[0039]

At the time of recording information onto the optical disc, the light amount is increased to induce a phase change in the recording layer of the optical disc made of a phase changing material, for example. In this case, the laser driving circuit 4 increases its light amount by increasing the laser driving current 6.

[0040]

Here, by setting the response band of the photodetecting element 2 to be sufficiently fast with respect to the frequency of the high-frequency superimposing, the signal outputted from the photodetecting element 2 can satisfactorily represent the waveform of the light emitted from the semiconductor laser. This has the waveform shown by the solid curve 51 in Fig. 6.

[0041]

Also, the peak value of the output signal is detected by the peak detecting circuit 7 and the average value is measured by the laser driving circuit 4. The high-frequency superimposing control device 5 calculates a ratio of the peak value and the average value and controls the amplitude of the superimposed high-frequency signal in such a manner that the ratio becomes lower than or equal to a constant value.

[0042]

With this construction, it is possible to prevent the peak of the outputted light from becoming unnecessarily high, and the superimposed high frequency signal can be kept at an amplitude

at which the recorded information on the optical disc is not damaged during reproduction.

[0043]

In general, the peak-to-average ratio increases as the temperature of the semiconductor laser 1 increases, even when the amplitude of the superimposed high-frequency signal is constant. Therefore, the high-frequency superimposing control section 5 controls the amplitude of the superimposed high-frequency signal in such a manner that the amplitude decreases.

[0044]

Further, when the output of the semiconductor laser 1 varies, in a range where the power to be output is less than a certain threshold value, the peak value 52 increases as the power increases, and the amplitude of the superimposed high-frequency signal is reduced due to the high-frequency superimposing control device 5. Further, in a range where the power is larger than the threshold value, the peak value 52 decreases as the power increases, and the amplitude of the superimposed high-frequency signal increases.

[0045]

(Second Embodiment)

Next, a second embodiment of the invention will be described with reference to Fig.2 and Fig. 6.

[0046]

Fig. 2 is a circuit block diagram showing a laser driving device according to a second embodiment of the invention. The constituent elements which is shown in Fig. 2 and have the same function as those described with reference to Fig. 1 are assigned the same reference number and the description thereof is hereby omitted.

【0047】

In Fig. 2, 8 denotes a storing section and 9 denotes a temperature sensor.

【0048】

The storing section 8 may use a semiconductor memory, for example.

【0049】

The storing section 8 stores data of a temperature and a peak value of an output light of the semiconductor laser 1 with respect to an average value at a time when the power changes.

【0050】

The temperature sensor 9 measures a temperature of the semiconductor laser to output an electric signal. The semiconductor laser 1 is a single-mode laser emitting light at a wavelength of 405nm, for instance. The semiconductor laser 1 emits light after receiving a laser driving current 6 which is outputted from the laser driving circuit 4. At this time, the laser driving current 6 is superimposed with a high-frequency signal, by means of the high-frequency superimposing circuit 3. The high-frequency superimposing circuit 3 is provided with an

oscillating circuit (not shown) which oscillates at a high frequency of around 200M~600MHz, for instance. The oscillating circuit is driven by a driving power source which is not shown, and a high-frequency signal is superimposed over the laser driving current 6, by means of an AC coupling.

【0051】

The laser driving current 6 which has been superimposed with a high-frequency signal is inputted into the semiconductor laser 1 and the single mode laser is made to function as a multi-mode laser to thereby emit light. Accordingly, the influence to the light returned from the disc or the like can be reduced, thereby reducing the noise.

【0052】

A major part of the light emitted from the semiconductor laser 1 is directed to the disc for recording or reproducing and a part thereof is received by the photodetecting element 2 which executes photoelectric conversion to thus-received light to output an electric signal which is proportional to the light amount.

【0053】

The laser driving circuit 4 captures the outputted electric signal and the current outputted from the laser driving circuit 4 is controlled in such a manner that a temporal average value, i.e. a direct current component of the signal is kept constant. As a result, the average value of the power of the light emitted from the semiconductor laser 1 is kept constant and the semiconductor laser can be caused to emit light at a desired output level.

【0054】

At the time of recording information onto the optical disc, the light amount is increased to induce a phase change in the recording layer of the optical disc made of a phase changing material, for example. In this case, the laser driving circuit 4 increases its light amount by increasing the laser driving current 6.

【0055】

Here, by setting the response band of the photodetecting element 2 to be sufficiently fast with respect to the frequency of the high-frequency superimposing, the signal outputted from the photodetecting element 2 can satisfactorily represent the waveform of the light emitted from the semiconductor laser 1. This has the waveform shown by the solid curve 51 in Fig. 6.

【0056】

At this time, it is determined in advance how the peak value 52 of the emitted light changes in accordance with the change of the temperature and output from the semiconductor laser 1. Information on such changes is stored in the storing section 8.

【0057】

Comparing the temperature information received from the temperature sensor 9 and the average value signal obtained by the laser driving circuit 4 which has received the output from the photodetecting element 2 with the information stored in the storing section 8, the amplitude of the high-frequency signal

superimposed by means of the high-frequency superimposing circuit 3 is increased in such a manner that the ratio of the peak value of the semiconductor laser 1 with respect to the average value does not exceed the constant value.

【0058】

It is therefore possible to prevent light having an unnecessarily high peak value from being irradiated onto the recording surface. This enables stable reproduction over a long period of time without damaging the signal recorded onto the optical disc.

【0059】

In this embodiment, there is no need for the photodetecting element 2 to detect the peak value of the light emitted from the semiconductor laser 1, which accordingly enable of use those for a relatively low frequency band.

【0060】

(Third Embodiment)

Next, a third embodiment of the invention will be described.

【0061】

The present embodiment differs from the laser driving device of the second embodiment in that an optical disc device is used herein as a storing section 8.

【0062】

The reading of this optical device is naturally carried out by the laser driving device of the embodiment.

【0063】

Each disc is written with information having a peak value 52 which is a limit likely to cause damage of information recorded on the disc. This information is read to control the high-frequency superimposing circuit 3. It is therefore possible to carry out the high-frequency superimposing operation of outputting a laser which has an optimal ratio of the peak value to the average value which does not damage the respective optical discs even in the case that the influence of the peak value 52 of the laser light to the respective optical discs is different from one another.

【0064】

(Fourth Embodiment)

Hereinafter, a fourth embodiment of the invention is described with reference to Fig. 3.

【0065】

Fig. 3 is a structural diagram showing an optical head device according to the fourth embodiment of the present invention. The constituting elements which are shown in Fig. 3 and have the same functions as those shown in Fig. 1 are assigned the same numerical symbol. In Fig. 2, 1 denotes a semiconductor laser having a driving device which uses the laser driving device described in embodiments 1 to 3 of the invention. 21 denotes a beam splitter for a front light monitor which separates a part of the forwarding light. 2 denotes a photodetector. 27 denotes a beam splitter which separates the returning light. 23 denotes a

condensing lens, 24 denotes a stand-up mirror, and 28 denotes a photodetector 28. 25 denotes an objective lens, and 26 denotes an optical disc.

[0066]

At the time of reproducing, a laser beam 22 having a wavelength 405 nm emitted from the semiconductor laser 1 is modulated into parallel beams by the condensing lens 23, and its light path is bent by the stand-up mirror 24, and then the beam enters the objective lens 25. A part of the emitted light is separated by the beam splitter 21 for a front light monitor in the course of its forwarding path, and the part of the separated light enters the photodetecting element 2. The light that comes through the objective lens 25 concentrates onto the optical disc 26. The light reflected by the optical disc 26 returns along the course reversal to the forwarding path from the objective lens, the stand-up mirror 24, and the condensing lens 23, and is reflected by the beam splitter 27 so as to enter the photodetector 28. The photodetector 28 performs photoelectric conversion to the entered light, and outputs it as an electric signal. The electric signal that is outputted by the photoelectric conversion of the photodetector 28 is used as an RF signal for pit rows on the optical disc 26 or a servo signal for tracing pit rows on the optical disc.

[0067]

When performing recording, basic operations are identical to those for reproducing, except that the amount of light

emitted from the semiconductor laser 1 is large for recording onto the optical disc 26.

【0068】

Since the optical head device basically includes the laser driving device of the invention, it is possible to provide an optical head device 31 which is capable of stably reproducing, over a long period of time, information recorded on the optical disc 26 without causing any damage to such information during the reproduction.

【0069】

(Fifth Embodiment)

A fifth embodiment of the invention is hereinafter described with reference to Fig. 4.

【0070】

Fig. 4 is a structural diagram of an optical information processing device according to the fifth embodiment of the invention.

【0071】

In Fig. 4, 31 denotes the optical head device described in the fourth embodiment of the invention. 26 denotes an optical disc, 32 denotes a motor which rotates supportingly the optical disc 26. 33 denotes a circuit board, and 34 denotes a power source unit.

【0072】

The optical disc is rotated by the motor 32. The optical head device 31 sends a signal corresponding to the positional relationship against the optical disc 26 to the circuit board 33.

The circuit board 33 calculates this signal and outputs a signal for making fine movement of the optical head device 31 or an objective lens in the optical head 31. The light head device 31 or the objective lens in the optical head 31 carries out a focus servo and a tracking servo with respect to the optical disc 26 by means of an un-illustrated driving mechanism, to thereby read, or write or erase information from or onto the optical disc 26. 34 denotes a connection section for connection with the power source unit or an external power source to supply electricity to the circuit board 33, the driving mechanism of the optical head device, the motor 32 and the driving device of the objective lens. Alternatively, connection terminals for connection with the power source or the external power source may be provided for each driving circuit.

【0073】

Since the optical information processing device employs the optical head device 31, the optical information processing device can stably reproduce information over a long period of time information recorded on the optical disc 26 without causing any damage to the information during such reproduction.

【0074】

【Effects of the Invention】

The semiconductor laser driving device of the invention comprises: a semiconductor laser; a high-frequency superimposing circuit for superimposing a high-frequency signal over a driving signal of the semiconductor laser; and a photodetecting element for receiving a part of light emitted from the semiconductor laser

and converting the part of light into an electric signal corresponding to a light amount; wherein an amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed in such a manner that a ratio of a peak value of the electric signal with respect to the average value of the electric signal becomes lower than or equal to a constant value. This makes it possible to provide a laser driving device which is capable of stably reproducing over a long period of time the signal recorded on the information storing medium while preventing such signal from being damaged at the time of reproduction.

【0075】

Also, a wavelength of the light emitted from the semiconductor laser is 390nm< λ <420nm. Accordingly, it is possible to provide a laser driving device which is capable of stably reproducing over a long period of time the signal recorded on the information storing medium, while preventing such signal from being damaged at the time of reproduction, even in case of employing an information storing medium having a high recording density and being liable to receive great signal deterioration influence of the peak power.

【0076】

Further, the amplitude of the signal to be superimposed by means of the high-frequency superimposing circuit is changed based on information regarding the peak value and average value of the signal acquired from the photodetecting element.

Accordingly, it is possible to provide a laser driving device which is capable of stably reproducing over a long period of time the signal recorded on the information storing medium, while preventing such signal from being damaged at the time of reproduction, even in case that the peak value characteristics with respect to the amplitude of the signal be subjected to high-frequency superimposing differ for each individual semiconductor laser.

【0077】

There are further provided a temperature sensor and a storing section. The amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed based on the temperature of the semiconductor laser detected by the temperature sensor and the conditions stored in the storing section. Accordingly, it is possible to provide a laser driving device which is capable of stably reproducing over a long period of time the signal recorded on the information storing medium, while preventing such signal from being damaged at the time of reproduction without detecting the peak value of the laser light.

【0078】

Further, an optical disc device is used as a storing section. The amplitude of the high-frequency superimposing circuit is further changed in accordance with the information stored on the optical disc. Accordingly, it is possible to provide a laser driving device which is capable of stably reproducing over a

long period of time the signal recorded on the information storing medium, while preventing such signal from being damaged at the time of reproduction, even in the case that optical discs have respectively great different powers which are likely to cause deterioration of a signal recorded on them.

【0079】

Further, the device is constructed in such a manner that the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit decreases as the temperature of the semiconductor laser increases. Accordingly, it is possible to provide a laser driving device which is capable of stably reproducing over a long period of time the signal recorded on the information storing medium, while preventing such signal from being damaged at the time of reproduction, even in the case that the temperature of the semiconductor laser changes.

【0080】

Further, the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit decreases as the light emission power increases when the light emission power of the semiconductor laser is equal to or less than a given threshold value, whereas the amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit increases as the light emission power increases when the light emission power of the semiconductor laser is equal to or larger than the threshold value.

Accordingly, it is possible to provide a laser driving device which is capable of stably reproducing over a long period of time the signal recorded on the information storing medium, while preventing such signal from being damaged at the time of reproduction, even in the case that the output of the semiconductor laser changes.

【0081】

Also, by employing the laser driving device of the invention, it is possible to provide an optical head capable of reproducing information with high reliability.

【0082】

Also, by employing the optical head of the invention, it is possible to provide an optical head capable of reproducing information with high reliability.

【Brief Description of the Drawings】

Fig. 1 is a circuit block diagram of a laser driving device according to a first embodiment of the invention.

Fig. 2 is a circuit block diagram of a laser driving device according to a second embodiment of the invention.

Fig. 3 is a structural diagram showing an optical head device according to a third embodiment of the invention.

Fig. 4 is a structural diagram showing an optical information processing device according to a forth embodiment of the invention.

Fig. 5 is a circuit block diagram of a conventional laser driving device.

Fig. 6 is a diagram showing the wavelength of the light outputted from the semiconductor laser at the time of high-frequency superimposing.

Fig. 7 is a diagram showing the wavelength of the light outputted from the semiconductor laser at the time of high-frequency superimposing.

【Description of the Numerical Symbols】

1 semiconductor laser

2 photodetecting element

3 high-frequency superimposing circuit

4 laser driving circuit

5 high-frequency superimposing control device

6 laser driving current

7 peak detecting circuit

11 area of an optical head main body

【Kind of Document】 Abstract

【Summary】

【Problem】

In the conventional structures, there is a risk that, at the time of reproducing information recorded on an optical disc, information on the optical disc is overwritten at a peak portion of the alternating current components of the laser beam which is generated by high-frequency superimposing, thereby damaging the recorded information.

【Means to Solve】

A device comprising: a semiconductor laser; a high-frequency superimposing circuit for superimposing a high-frequency signal over a driving signal of the semiconductor laser; a photodetecting element for receiving a part of light emitted from the semiconductor laser and converting the part of light into an electric signal corresponding to a light amount; wherein an amplitude of the high-frequency signal to be superimposed by means of the high-frequency superimposing circuit is changed in such a manner that a ratio of a peak value of the electric signal with respect to the average value of the electric signal becomes lower than or equal to a constant value.

【Selected Figure】 Fig. 1

FIG. 1

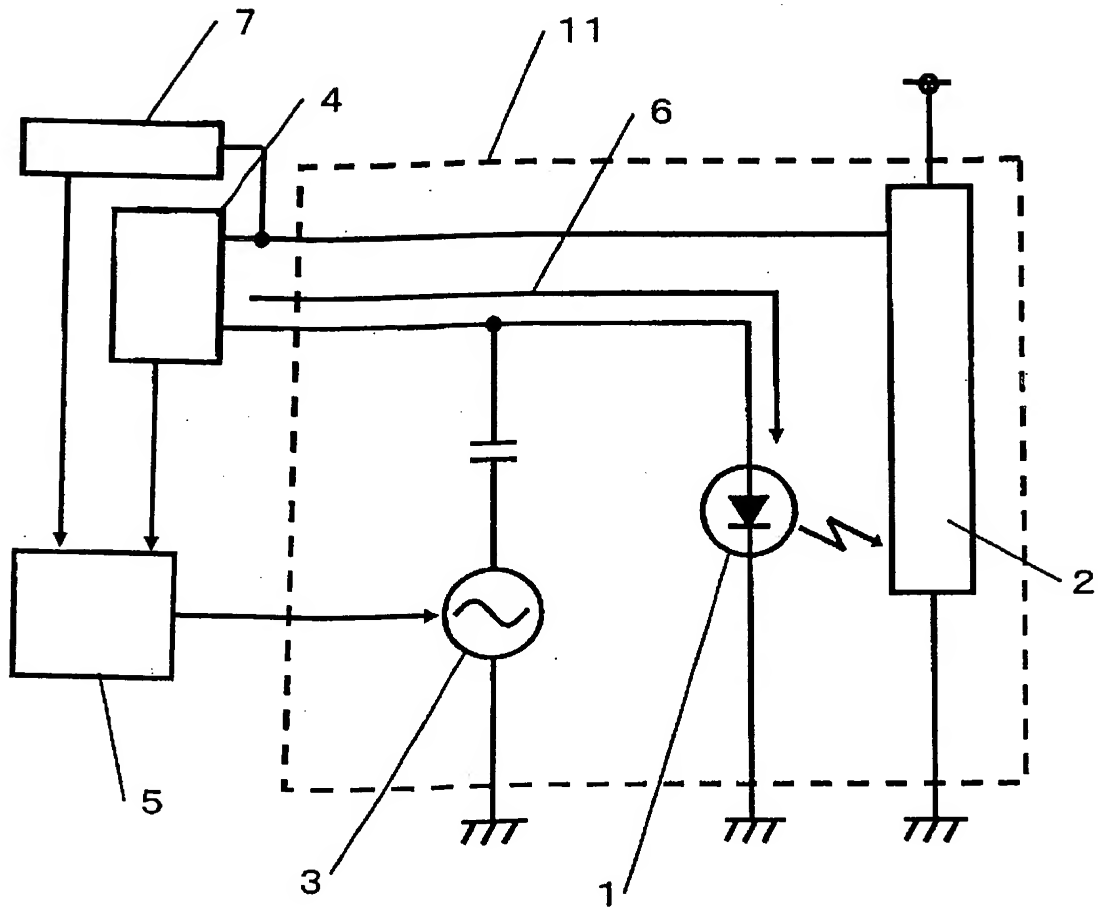

FIG. 2

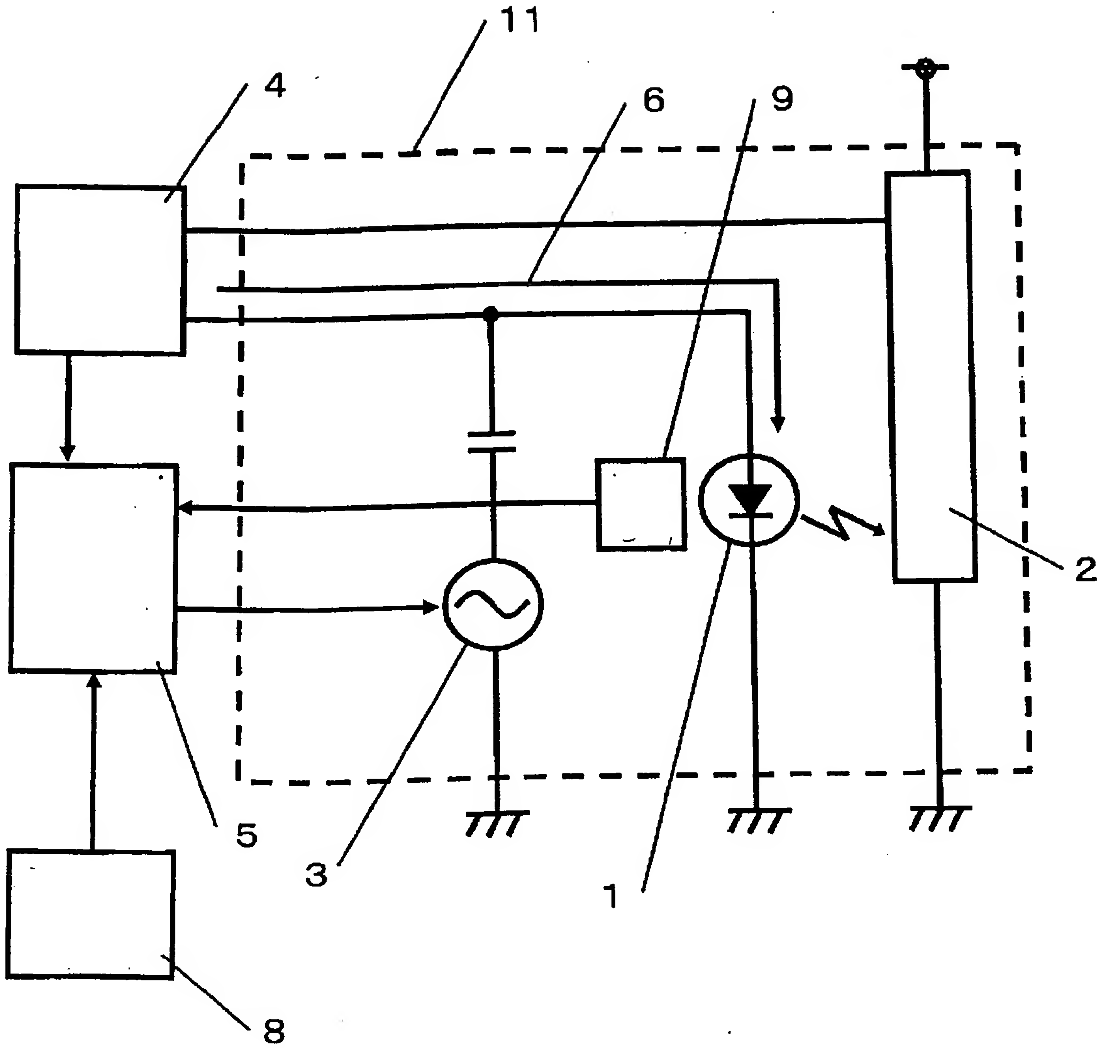

FIG. 3

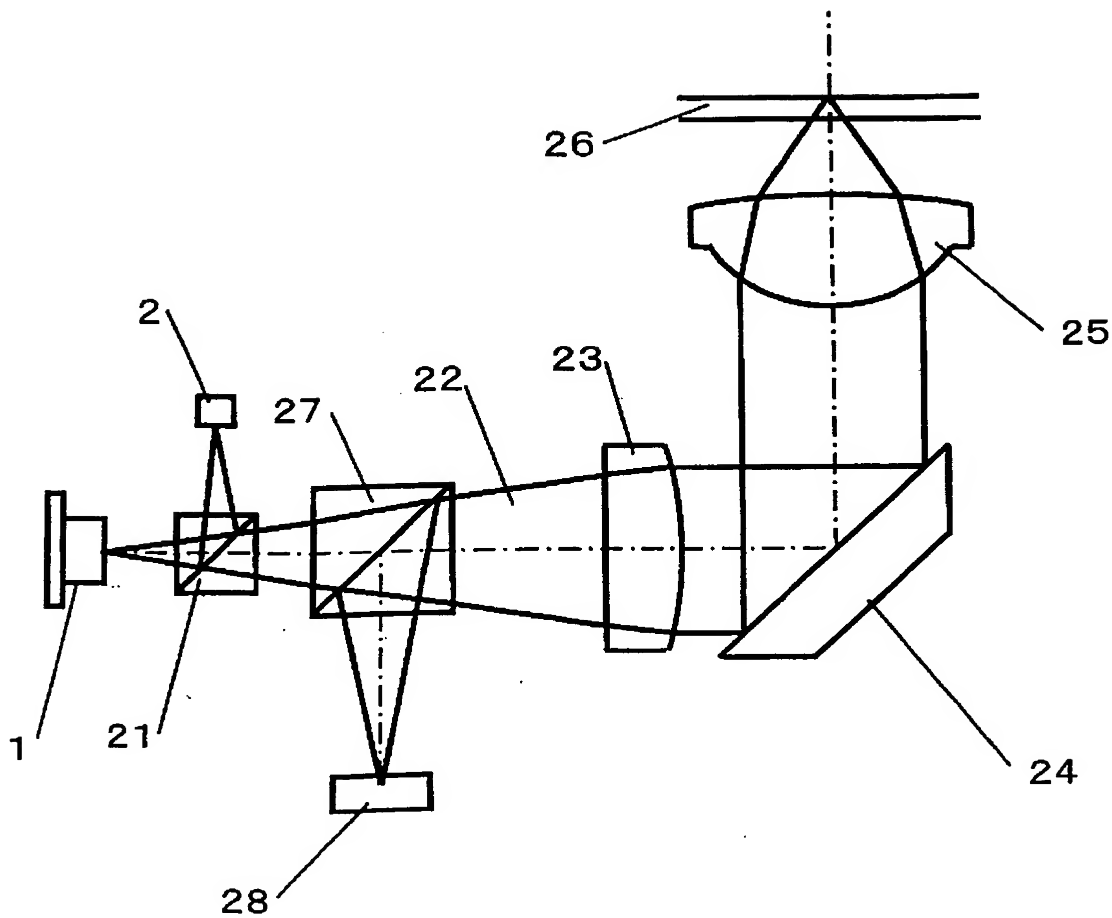

FIG. 4

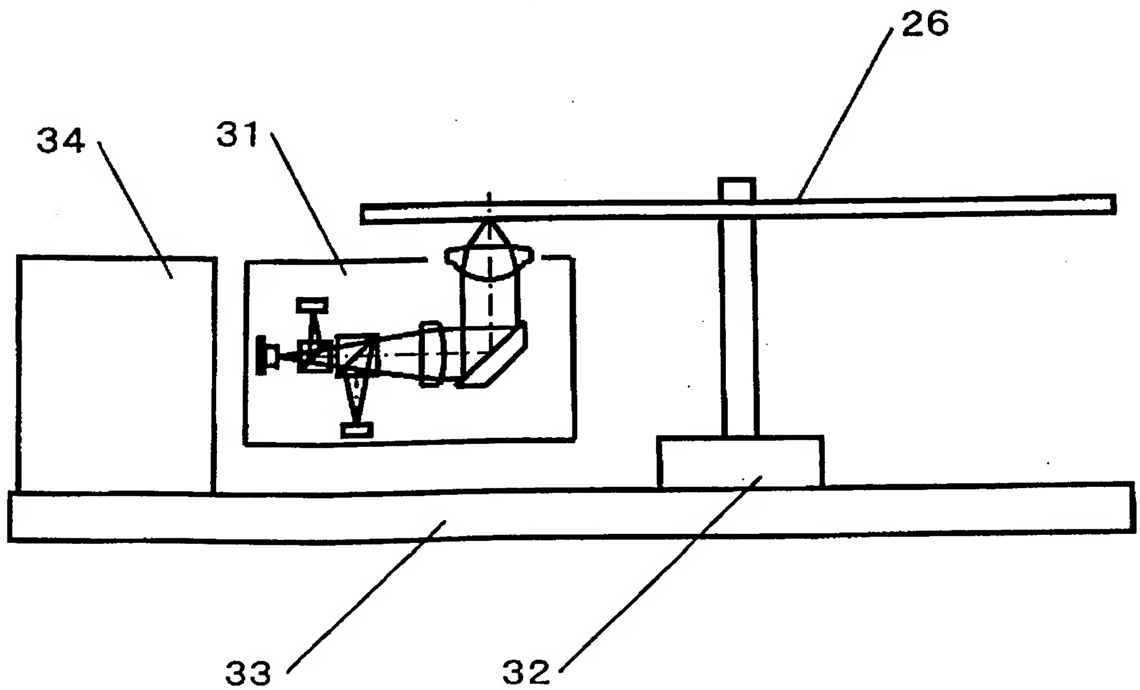

FIG. 5

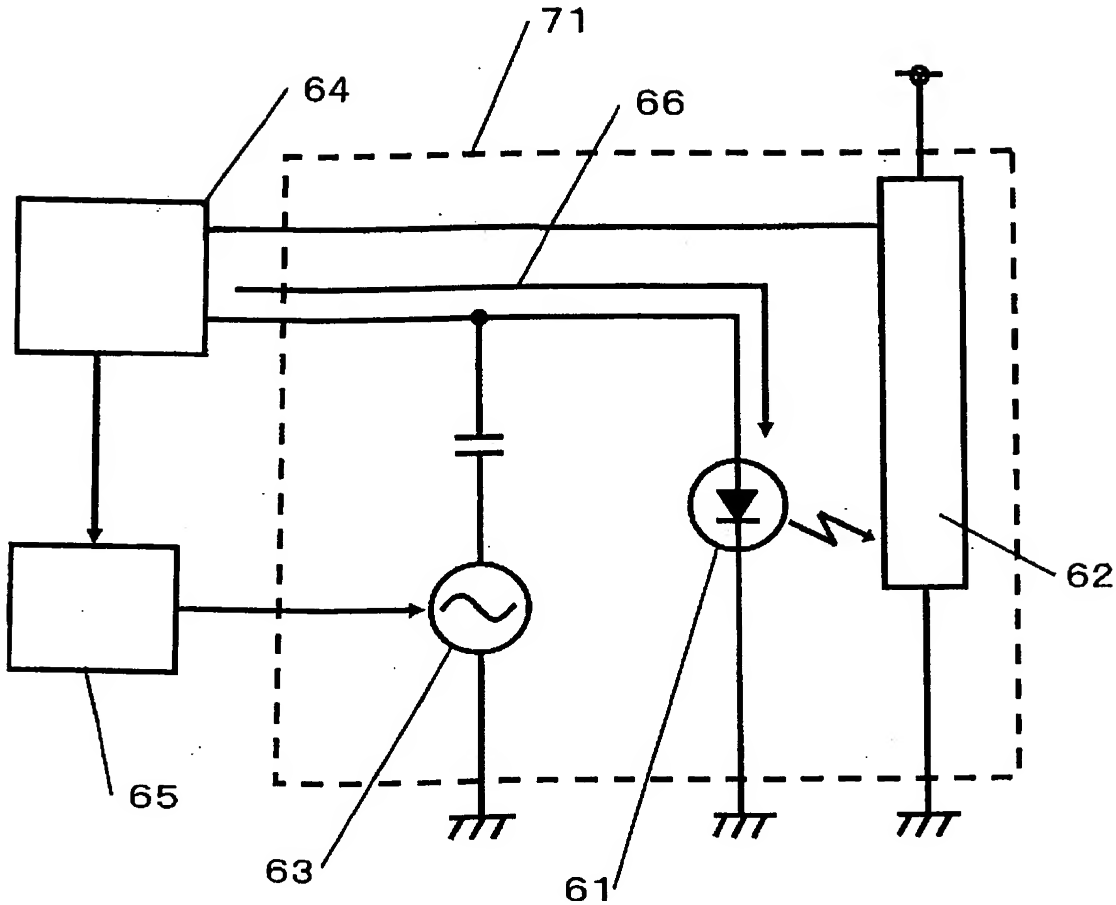

FIG. 6

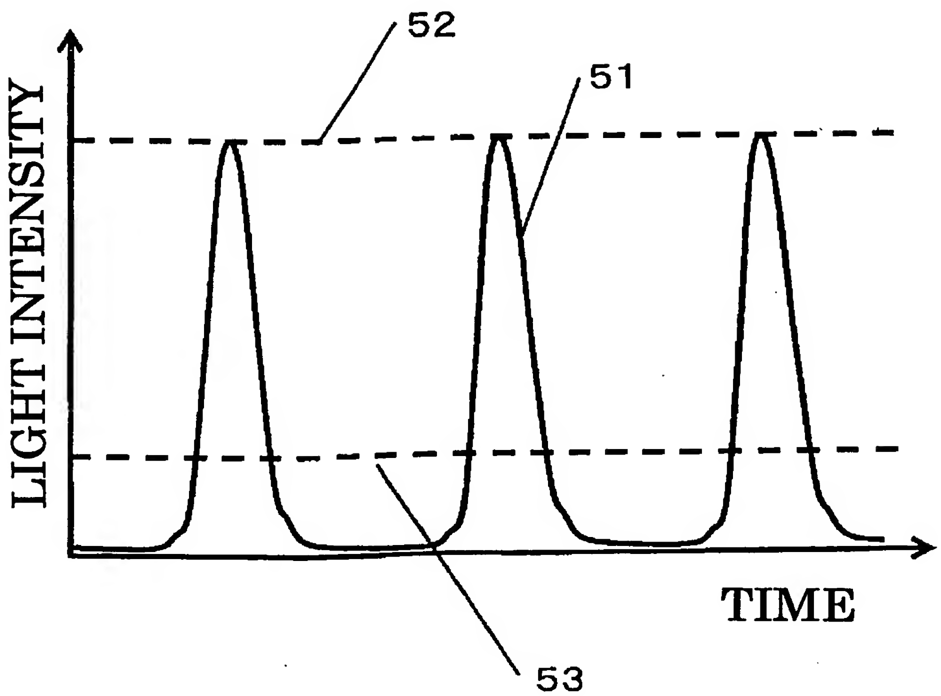

FIG. 7